CLAIMS

What is claimed is:

1.   An encoding apparatus, comprising:

a first soft encoder performing a first soft encoding to correct errors in input data and outputting first soft-encoded data; and

a second soft encoder receiving the first soft-encoded data, performing a second soft encoding to determine a success or failure of the encoding of the first soft-encoded data, and outputting second soft-encoded data.

2.   The encoding apparatus of claim 1, wherein the first soft encoder uses a turbo encoding method.

3.   The encoding apparatus of claim 1, wherein the second soft encoder uses a Low Density Parity Check (LDPC) coding method.

4.   The encoding apparatus of claim 1, further comprising:

an interleaver interleaving the first soft-encoded data in a predetermined interleaving order.

5.   The encoding apparatus of claim 4, wherein the interleaver interleaves the first encoded data with code block units and generates interleaved code blocks having a same number of code blocks as the code blocks of the second soft encoder.

6.   The encoding apparatus of claim 4, wherein the interleaver interleaves an area from a middle of a code block of the first soft encoder to the middle of a next code block thereof as an interleaving unit when the first and the second soft encoders have a same value in corresponding code block unit sizes, and generates the interleaved data, wherein two code blocks of the first soft encoder have influence on a creation of one code block of the second soft decoder.

7.   A decoding apparatus, comprising:

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a first soft decoder performing a first soft decoding of input data to correct errors in the input data and outputting first soft-decoded data; and

a second soft decoder receiving the first soft-decoded data, performing a second soft decoding of the first soft-decoded data, and outputting second soft-decoded data and additional information indicating a success or failure of the decoding of the first soft-decoded data.

8.   The decoding apparatus of claim 7, wherein the first soft decoder uses a turbo decoding method.

9.   The decoding apparatus of claim 7, wherein the second soft decoder uses a Low Density Parity Check (LDPC) decoding method.

10.   The decoding apparatus of claim 7, wherein the first soft decoder repeatedly decodes the second soft-decoded data fed back in response to the additional information indicating the failure of the decoding.

11.   The decoding apparatus of claim 7, further comprising:

a de-interleaver de-interleaving the first soft-decoded data corresponding to an interleaving order used upon encoding; and

an interleaver which, according to the additional information, performs a hard-decision for successfully decoded data to restore original data, puts a soft output of the second soft decoder in a space of non-decoded data, performs interleaving, and feeds back the interleaved data to the first soft decoder, wherein the first soft decoder performs repeated decoding.

12.   The decoding apparatus of claim 7, further comprising:

a de-interleaver de-interleaving the first soft-decoded data corresponding to an interleaving order used upon encoding;

an interleaver which, according to the additional information, performs a hard-decision for successfully decoded data of the second soft-decoded data to restore original data, keeps a space of non-decoded data of the second soft-decoded data empty, performs interleaving, and outputs the interleaved data; and

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a data insertion unit inserting an output of the first soft decoder in the empty space of the interleaved data output from the interleaver and feeding back resulting data indicative thereof to the first soft decoder,

wherein the first soft decoder performs repeated decoding.

13.   An encoding and decoding apparatus, comprising:

a first soft encoder performing a first soft encoding of input data to correct errors in the input data and outputting first soft-encoded data;

a second soft encoder receiving the first soft-encoded data, performing a second soft encoding to determine a success or failure of the encoding of the first soft-encoded data, and outputting second soft-encoded data;

a transmission channel;

a first soft decoder soft-decoding data input through the transmission channel and corresponding to the second soft encoding, and outputting first soft-decoded data; and

a second soft decoder receiving the first soft-decoded data, soft-decoding the first soft-decoded data corresponding to the first soft encoding, and outputting second soft-decoded data and additional information indicating the success or failure of the decoding of the first soft-decoded data.

14.   The encoding and decoding apparatus of claim 13, wherein the first soft encoding is implemented by a turbo encoding method.

15.   The encoding and decoding apparatus of claim 13, wherein the second soft encoding is implemented by a Low Density Parity Check (LDPC) coding method.

16.   The encoding and decoding apparatus of claim 13, further comprising:

an interleaver which interleaving the first soft-encoded data in a predetermined interleaving order.

17.   The encoding and decoding apparatus of claim 16, wherein the interleaver interleaves the first encoded data with code block units and generates interleaved code blocks having a same number of code blocks as the code blocks of the second soft encoder.

18.   The encoding and decoding apparatus of claim 16, wherein the interleaver interleaves an area from a middle of a code block of the first soft encoder to the middle of a next code block thereof as an interleaving unit when the first and the second soft encoders have a same value in corresponding code block unit sizes, and generates the interleaved data, wherein two code blocks of the first soft encoder have influence on a creation of one code block of the second soft decoder.

19.   The encoding and decoding apparatus of claim 13, wherein the first soft decoder repeatedly decodes the second soft-decoded data fed back in response to the addition information indicating the failure of decoding.

20.   The encoding and decoding apparatus of claim 13, further comprising:

a de-interleaver de-interleaving the first soft-decoded data corresponding to an interleaving order used upon encoding; and

an interleaver which, according to the additional information, performs a hard-decision for successfully decoded data to restore original data, puts a soft output of the second soft decoder in a space of non-decoded data, performs interleaving, and feeds back the interleaved data to the first soft decoder, wherein the first soft decoder performs repeated decoding.

21.   The encoding and decoding apparatus of claim 13, further comprising:

a de-interleaver de-interleaving the first soft-decoded data corresponding to an interleaving order used upon encoding;

an interleaver which, according to the additional information, performs a hard-decision for successfully decoded data of the second soft-decoded data to restore original data, keeps a space of non-decoded data of the second soft-decoded data empty, performs interleaving, and outputs the interleaved data; and

a data insertion unit inserting an output of the first soft decoder in the empty space of the interleaved data output from the interleaver and feeding back resulting data indicative thereof to the first soft decoder,

wherein the first soft decoder performs repeated decoding.

22.   An encoding method, comprising:

performing a first soft encoding of input data to correct errors in the input data and outputting first soft-encoded data; and

performing a second soft encoding to determine a success or failure of the encoding of the first soft-encoded data.

23.   The encoding method of claim 22, further comprising:

implementing the first soft encoding using a turbo encoding method.

24.   The encoding method of claim 22, further comprising:

implementing the second soft encoding is using a Low Density Parity Check (LDPC) coding method.

25.   The encoding method of claim 22, further comprising interleaving the first soft-encoded data in a predetermined interleaving order.

26.   The encoding method of clam 25, wherein in the interleaving, the first soft-encoded data is interleaved with code block units, and generates interleaved code blocks having a same number of code blocks as the code blocks of the second soft encoder.

27.   The encoding method of claim 25, wherein in the interleaving, an area from a middle of a soft code block to the middle of a next soft code block thereof is interleaved as an interleaving unit when the first and the second soft encoders have a same value in corresponding code block unit sizes, and generates interleaved data, wherein two code blocks of the first soft encoder have influence on a creation of one code block of the second soft decoder.

28.   A decoding method, comprising:

performing a first soft decoding of input data to correct errors in the input data and outputting first soft-decoded data; and

performing a second soft decoding of the first soft-decoded data.

29.   The decoding method of claim 28, further comprising:

implementing the first soft decoding using a turbo decoding method.

30.   The decoding method of claim 28, further comprising:

implementing the second soft decoding is using a Low Density Parity Check (LDPC) decoding method.

31.   The decoding method of claim 28, wherein the first soft-decoding further comprises:

performing repeated decoding of the second soft-decoded data fed back in response to the additional information indicating the failure of the decoding.

32.   The decoding method of claim 28, further comprising:

de-interleaving the first soft-decoded data corresponding to an interleaving order used upon encoding; and

according to the additional information performing a hard-decision to successfully decode the data to restore original data, putting a soft output of the second soft decoder in a space of non-decoded data, interleaving the data, and feeding back the interleaved data to the first soft decoder, wherein the first soft decoding is performed repeatedly.

33.   The decoding method of claim 28, further comprising:

de-interleaving the first soft-decoded data corresponding to the interleaving order used upon decoding;

according to the additional information, performing a hard-decision to successfully decode the data of the second soft-decoded data to restore original data, keeping a space of non-decoded data of the second soft-decoded data empty, interleaving, and outputting the interleaved data;

inserting the first soft-decoded data in the empty space of the interleaved data; and

performing the first soft decoding of the resulting data, wherein the first soft decoding is performed repeatedly.

34.   An encoding and decoding method, comprising:

performing a first soft encoding of input data to correct errors in the input data and outputting first soft-encoded data;

performing a second soft encoding to determine a success or failure of the encoding of the first soft-encoded data;

soft-decoding data input through a transmission channel, wherein the soft-decoding corresponds to the second soft-encoding;

soft-decoding the first soft-decoded data corresponding to the first soft-encoding; and

outputting second soft-decoded data and additional information indicating the success or failure of the decoding of the first soft-decoded data.

35.   The encoding and decoding method of claim 34, further comprising:
implementing the first soft encoding using a turbo encoding methods.

36.   The encoding and decoding method of claim 34, further comprising:
implementing the second soft decoding is using a Low Density Parity Check (LDPC) coding method.

37.   The encoding and decoding method of claim 34, further comprising:
interleaving the first soft-encoded data in a predetermined interleaving order.

38.   The encoding and decoding method of claim 37, wherein in the interleaving, the first soft-encoded data is interleaved with code block units, and generates interleaved code blocks having a same number of code blocks as the code blocks of the second soft encoder.

39.   The encoding and decoding method of claim 37, wherein in the interleaving, an area from a middle of a soft code block to the middle of a next soft code block is interleaved as an interleaving unit when the first and the second soft-encoded data have a same value in corresponding code block unit sizes, to generate interleaved data, wherein two first soft code blocks have influence on a creation of one second soft code block.

40.   The encoding and decoding method of claim 34, wherein the first soft decoding further comprises:
performing repeated decoding of the second soft-decoded data fed back in response to the addition information indicating the failure of the decoding.

41.   The encoding and decoding method of claim 34, further comprising:

de-interleaving the first soft-decoded data corresponding to the interleaving order used upon encoding; and

according to the additional information performing a hard-decision to successfully decode the data to restore original data, putting a soft output of the second soft decoder in a space of non-decoded data, interleaving the data, and feeding back the interleaved data to the first soft decoder, wherein the first soft decoding is performed repeatedly.

42.   The encoding and decoding method of claim 34, further comprising:

de-interleaving the first soft-decoded data corresponding to an interleaving order used upon encoding;

according to the additional addition, performing a hard-decision to successfully decode the data of the second soft-decoded data to restore original data, keeping a space of non-decoded data of the second soft-decoded data empty, interleaving, and outputting interleaved data; and

inserting the first soft-decoded data in the empty space of the interleaved data and performing the first soft decoding of result data indicative thereof,

wherein the first soft decoding is performed repeatedly.

43.   A computer readable medium storing a computer program to execute an encoding method, comprising:

performing a first soft encoding of input data to correct errors in the input data and outputting first soft-encoded data; and

performing a second soft encoding to determine a success or failure of the encoding of the first soft-encoded data.

44.   A computer readable medium storing a computer program to execute a decoding method, comprising:

performing a first soft decoding of input data to correct errors in the input data and outputting first soft-decoded data; and

performing a second soft decoding of the first soft-decoded data.

45.   A computer readable medium storing a computer program to execute an encoding and decoding method, comprising:

performing a first soft encoding of input data to correct errors in the input data and outputting first soft-encoded data;

performing a second soft encoding to determine a success or failure of the encoding of the first soft-encoded data;

soft-decoding data input through a transmission channel, wherein the soft-decoding corresponds to the second soft-encoding;

soft-decoding the first soft-decoded data corresponding to the first soft-encoding; and

outputting second soft-decoded data and additional information indicating the success or failure of the decoding of the first soft-decoded data.